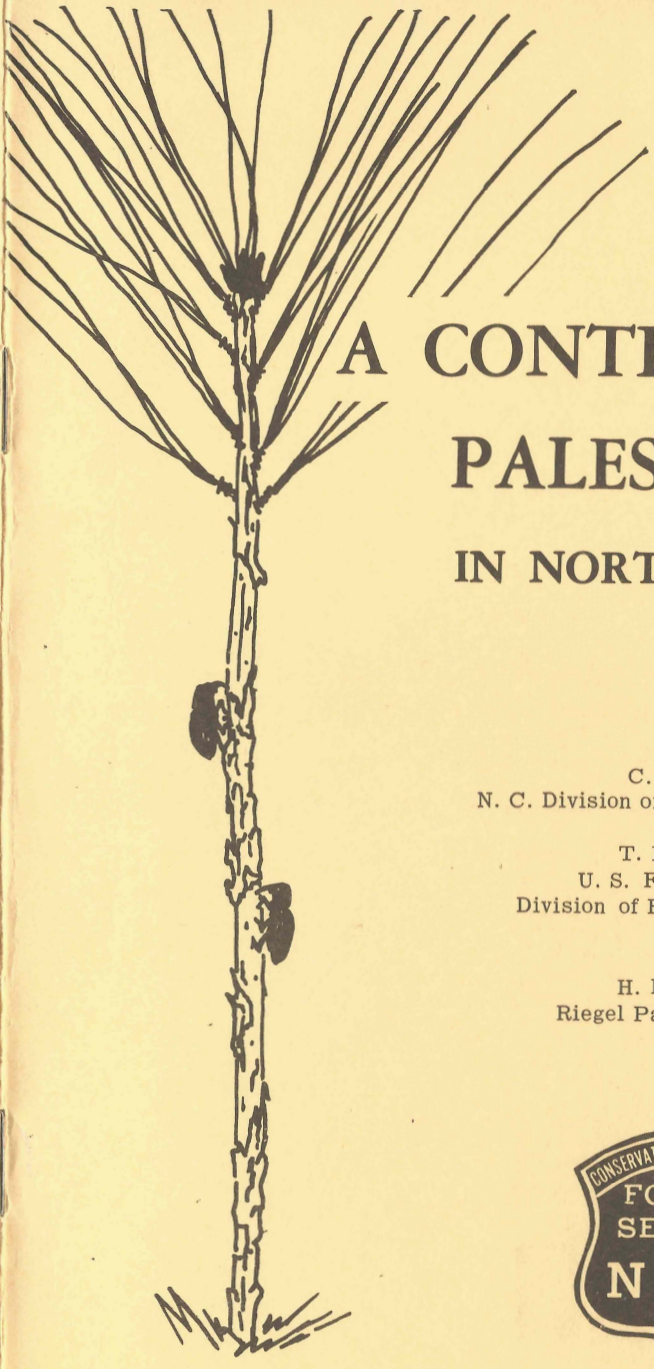


A CONTROL FOR PALES WEEVIL IN NORTH CAROLINA

BY

C. R. Grady
N. C. Division of Forestry, Pest Control

T. H. Flavell
U. S. Forest Service,
Division of Forest Pest Control,
Zone 1

H. F. Layman
Riegel Paper Corporation

DIVISION OF FORESTRY—DEPARTMENT OF CONSERVATION AND DEVELOPMENT

ACKNOWLEDGEMENTS

A large measure of credit is due to H. J. Green, Assistant State Forester, N. C. Division of Forestry who coordinated most of the efforts for the study. Mr. J. B. Lattay, Vice President, Woodlands Department, Carolina Division, Riegel Paper Corporation offered immeasurable assistance in providing facilities and personnel. Acknowledgement is gratefully made to Dr. R. F. Anderson, Professor of Forest Entomology, Duke University; Dr. H. A. Thomas, U. S. Forest Service, Southeastern Research Station, Durham; R. K. Smith, Assistant Area Director, Pest Control, Southeastern Area, State and Private Forestry, U. S. Forest Service: W. M. Ciesla, Zone Leader, Zone 1, Pest Control Division, State and Private Forestry, U. S. Forest Service; and other entomologists and foresters too numerous to mention individually whose advice and assistance provided the basis for this project.

A CONTROL MEASURE For PALES WEEVIL In SOUTHEASTERN NORTH CAROLINA

1967

C. R. Grady
N. C. Division of Forestry, Pest Control

T. H. Flavell
U. S. Forest Service, Division of Forest Pest Control, Zone 1

H. F. Layman
Riegel Paper Corporation

TABLE OF CONTENTS

DIGEST

OBJECTIVE

A two-phase pilot study was initiated in January 1966, to evaluate the effectiveness of DDT in controlling pales weevil in recently established pine plantations. The object of the study was to determine if spraying the seedlings in the nursery with DDT plus applying granular DDT to the soil following out-planting would provide satisfactory protection against pales weevil, *Hylobius pales* (Hbst.).

METHODS AND SCOPE OF INVESTIGATION

A total of 2,000 pine seedlings were observed monthly during the months of February to December inclusively for weevil feeding. The observed seedlings were representative samples established in four treatment blocks with one replication. The results were analyzed statistically to determine the success of the various treatments.

CONCLUSIONS

The conclusions are:

(1) That a combination DDT treatment of nursery spray and granular application will reduce seedling losses by pales weevil to 11% and below.

(2) That a DDT treatment of nursery spray alone provides considerable protection against pales damage.

RECOMMENDATIONS

The recommendations are:

(1) That where chemical measures are necessary to control pales weevil a combination DDT nursery spray plus granular application be used on areas supporting extremely large weevil populations.

(2) That nursery spraying with DDT only be used on areas supporting light to moderate weevil populations.

THE APPLICATION OF A TWO-STAGE CONTROL FOR PALES WEEVIL

HISTORY OF THE PALES WEEVIL

GENERAL

A native of North America, the pales weevil was first described in 1797 by J. F. W. Herbet. Its potential as a destructive forest pest went almost unrecognized, however, until 1916 when it was found to be responsible for the almost complete failure of white pine plantations established on cut-over pine land in New England (Carter 1916). Once the pest was recognized, reports of pales damage became common throughout the range of eastern white pine, *Pinus strobus*. The first report of pales damage in the South came in 1940 when Beal and McClintick found it causing serious losses in loblolly pine, *P. taeda*, and shortleaf pine, *P. echinata*, plantations on the Duke Forest in North Carolina. By 1949, plantations in north central Louisiana established on recently burned over areas were suffering up to 90% mortality (Sentell 1949). The pales weevil is now known to be distributed throughout the eastern range of pine from Ontario, Canada to Texas.

Although white pine is generally regarded as the preferred host, pales weevils have been reported feeding on a wide variety of coniferous species. Few, if any, of the conifers found in the South may be expected to be immune to attack. Carter (1916) observed adult pales feeding on species of the following genera: *Pinus, Abies, Picea* and *Pseudotsuga*. He also found damage characteristics of pales on species of *Larix, Tsuga,* and *Juniperous,* but did not see adults in the act of feeding. One species, northern white cedar, *Thuja occidentalis,* was reported to be rejected as food by the weevil. Five years later, Peirson (1921) confirmed species of *Larix, Tsuga,* and *Juniperous* as host plants and, in contrast to Carter's observations, found feeding on species of *Thuja, Betula* and *Fraxinus*, the latter two hardwoods being fed upon only when other food was not available.

Egg laying is apparently sporadic. Finnegan (1959) found that the female would lay one to three eggs per day, but would often go several days without ovipositing. The eggs are laid in small nitches chewed in the bark of the host. About 80% of the eggs are laid in the lateral roots of fresh stumps or weakened trees, the remaining 20% being deposited around the root collar just below the ground line (Finnegan 1959). In addition, oviposition has been observed in pine logs and large slash material, particularly around wounds and the cut ends. Beal and McClintick (1940) found, in contrast to Pierson, that no successful brood developed in such material. The authors, however, have observed pales pupa and adults in slash material that had been buried in moist organic soil during site preparation.

According to Finnegan, the eggs hatch in ten to fourteen days and the grub-like larvae feed in the root cambium for about forty-seven days. During this time, five or six instars are passed. In the small lateral roots, the galleries run with the grain, but wander at random in larger material. Mature larvae construct a pupal chamber in the sapwood. about ¼ of an inch deep and parallel to the grain. After resting several days, the larvae encase themselves in a cocoon made of the excelisor-like material removed during the construction of the pupal chamber. In pond pine, pupation has been observed in the inner bark without the construction of a pupal chamber in the sapwood. Pupation lasts for about twenty days (Finnegan 1959).

In North Carolina, there is one complete generation and a partial second generation per year (Beal and McClintick 1940). Eggs deposited by June pupate and emerge in the fall while the remaining 30% overwinter as fifth and sixth instar larvae. Adults emerging in the fall lay eggs which produce adults the following spring. Thus in the spring, the weevil population consists of overwintered adults and emerging adults from overwintered larvae. In the fall, both of these groups of adults are present, plus adults that have emerged from eggs deposited in the spring.

Two seasonal peaks in damage are evident in North Carolina. The first and highest peak occurs in early spring, and is the result of overwintered and emerging adults. The second, and usually smaller peak in the fall, is caused primarily by adults from eggs laid in the spring, which feed briefly before migrating to freshly cut areas.

Pales weevils are long lived. In rearing studies, Finnegan (1959) found that approximately 35% of the adults overwintered twice. Suratino (unpublished Masters theses) found that winter mortality was greatly reduced when feeding occurred at intervals through the winter. Research is currently underway to learn more about the life history of pales in North Carolina.

Damage is usually centered around stumps or other attractive material. Beal and McClintick (1940) and Friend and Chamberlin (1941) pointed out that the closer a seedling was to a stump, the greater were its chances of being attacked by pales weevils. Once attacked, the weevils chew off the tender bark in characteristic irregular patches. Larger trees are also susceptible to feeding damage with twig and branch damage being reported on trees up to 35 feet tall (Beal and McClintick 1940).

NATURE OF THE PROBLEM

Damage caused by pine reproduction weevils is becoming increasingly serious in pine plantations throughout the South. Two species of beetles, the pales weevil, *Hylobius pales (Hbst.)*, and the pitch-eating weevil, *Pachylobius picivorus* (Germ.) are chiefly responsible. The destruction wrought by these insects may be expected to increase as more and more forest managers turn to planting as a means of immediately re-establishing pine on recently cut over pine lands. Present silvicultural practices create highly favorable conditions for these insects. Frequent thinnings and clear cutting of large blocks of pine assure an abundant source of breeding material for the maintenance of large populations of reproduction weevils. When the seedlings are set out, the weevils are ready to attack in force, sometimes causing up to 90% mortality (Sentell 1949).

In North Carolina, the pales weevil has become a critical problem in the coastal plain region on drained organic soil types being converted from pond pine *(Pinus serotina* Michx.) to loblolly pine *(P. taeda L.)* and slash pine *(P. elliottii* Engelm.). For economic and silvicultural reasons, it is not practical to wait until the areas lose their attractiveness to the weevils. Successful establishment of pine is, therefore, dependent upon chemical control of the pales weevil.

Various chemicals have been tested and used on the pales weevil (Thatcher, 1958, Speers, 1956, 1958). Despite its high mammalian toxicity, a 2% Aldrin seedling dip has been recommended for control of reproduction weevils. Results of tests undertaken in western North Carolina showed Aldrin superior to DDT as a seedling spray (Speers 1956). However, tests undertaken on pocosin type areas in southeastern North Carolina (Speers, unpublished, 1965) indicate that better control was obtained using DDT. Additionally, in 1965, a control project using Aldrin as a dip and an aerial spray was conducted on lands belonging to Riegel Paper Corporation in southeastern North Carolina. The results of this project were not completely satisfactory. Therefore, because of its much lower mammalian toxicity, DDT is considered to be more desirable than Aldrin when used as a seedling dip or nursery spray. DDT also affords protection over long periods of time, a requirement that is essential in eastern North Carolina because considerable mortality occurs in the fall from feeding by emerging adult weevils.

THE TWO-STAGE TREATMENT

In 1966, a pilot project was undertaken in southeastern North Carolina to evaluate the effectiveness on an operational scale of DDT in controlling pales weevil. The project was conducted by the North

Carolina Division of Forestry in cooperation with Riegel Paper Corporation and the U. S. Forest Service, Southeastern Area, State and Private Forestry, Division of Pest Control.

In order to assure adequate protection, a two-stage treatment was decided upon. The first stage consisted of a five per cent DDT nursery spray, the second stage was a broadcast application to outplanted areas of 8 lbs./acre of 12.5% of DDT granular, which resulted in an application of 1 lb. actual DDT per acre. It was felt that the nursery spray would protect the seedlings well into the summer months, and that the granular would extend this protection until cool weather by reducing the weevil population, while also being effective against adults emerging in the fall.

DETERMINATION OF PROBLEM AREAS

The areas selected to be treated were those which had been logged or site prepared after mid-June and planted with nursery sprayed seedlings. Based upon past experience, areas on which the weevil hazard was considered extreme were chosen to receive the granular treatment. These areas generally were composed of deep organic soil, contained a high amount of pine residue following site preparation and had been both logged and site prepared after mid-June.

High Weevil Hazard Area Immediately Following Logging

NURSERY SPRAY TREATMENT

Seedlings were treated in the nursery beds with a five per cent DDT emulsion spray. A Triton B-1956 spreader-sticker was added to

the emulsion to act as a bonding agent for the DDT. Approximately forty-five thousand seedlings were treated with the DDT spray to which a resin base Pinolene extender had replaced the Triton. These seedlings were used only in the test blocks. The spraying operation was undertaken immediately prior to lifting, and the seedlings were drenched to the point of run-off by hand spraying. Cost of this operation amounted to approximately $.25 per thousand seedlings.

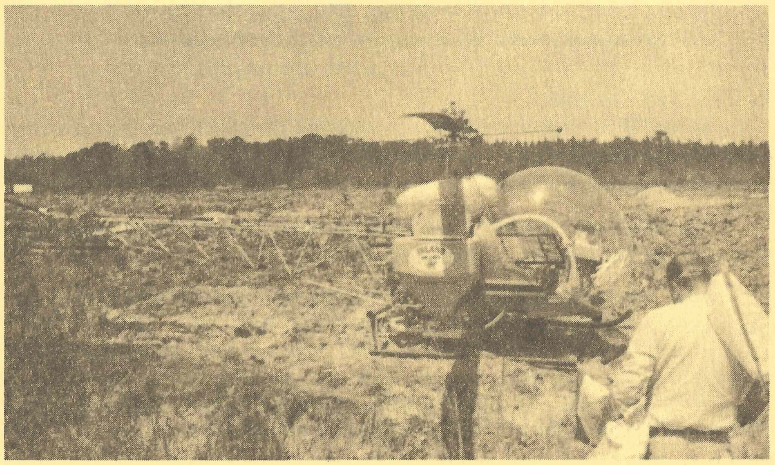
GRANULAR TREATMENT

1. Material

The material used for the granular application consisted of 12.5% DDT by weight on 20-40 mesh Florex granules.

2. Equipment

The granular application was made aerially using a G-4 Bell helicopter equipped with standard direct seeding apparatus. The material was gravity fed from hoppers mounted on each side of the craft into two continuous conveyors and was thus directed via hose to a single centrifugal "slinger" type applicator mounted beneath the craft.



G-4 Bell Helicopter Used For Application of Granular Insecticide

3. Application

The granular application was made in late April and was put down in fifty-foot swaths at the rate of eight pounds per acre. Application was made from an altitude of fifty feet at a forward speed of sixty miles per hour. All applications were made when wind speeds were below 10 miles per hour to avoid drift. Alternate flight lines were

permanently established at 100-foot intervals and were pre-marked with aluminum pie tins stapled to wooden stakes.

Helicopter Applying Granular DDT to Outplanted Area

4. Personnel Required

In addition to the pilot and mechanic, two men were required to load the insecticide into the helicopter and to transport the material between treatment areas.

One operational director was responsible for the overall operational control of the project.

One technical director was responsible for all entomological phases of the project.

5. Costs

Material costs for the granular insecticide was $.60 per acre. Cost of contracting the helicopter and pilot was $1.50 per acre.

6. Safety

Strict control measures were maintained throughout the application to assure that no streams, canals, farms, or other protected areas were contaminated by the insecticide. A buffer zone of twenty-five feet was maintained around all such areas. Although the DDT in dry form is not absorbed through the skin, there is some danger of oral toxicity; therefore, all personnel loading the helicopter were required to wear masks to avoid breathing the dust.

EVALUATION

Two 125 acre tracts were chosen as test sites. Both tracts had been logged and site prepared in late summer and fall and planted in January and February. One area was chosen on organic soil and the other on a more mineral soil. Both areas were purposely chosen for their high weevil hazard potential. The test areas were divided into five equal blocks of twenty-five acres. One of four seedling treatments was installed on each of the 25-acre blocks. The fifth block received no treatment and served as a control. The four treatments consisted of:

1. Five per cent DDT with Triton B-1956 sticker sprayed in the nursery.
2. Five per cent DDT with Triton B-1956 sprayed in the nursery followed by an application of 12.5% DDT granular applied at the rate of eight pounds per acre.
3. Five per cent DDT with Pinolene extender sprayed in the nursery. This treatment was installed to evaluate the effectiveness of Pinolene as an extender of DDT.
4. Five per cent DDT with Pinolene sprayed in the nursery followed by an application of 12.5% DDT granular at the rate of eight pounds per acre.

Twenty plots of ten seedlings per plot were spaced systematically over each twenty-five acre block. All seedlings in the plots were examined for weevil damage each month between February and December 1966.

CONCLUSIONS

Cumulative seedling mortality is shown in Figures 1 and 2. Feeding began very soon after planting on the organic soil, and mortality reached a peak by June, after which it leveled off showing only a slight increase again in the fall. On mineral soil feeding did not begin until April and mortality did not reach a peak until October.

Adequate control was given by both DDT-Triton and DDT-Pinolene nursery sprays when used in conjunction with the 12.5% granular applied at the rate of eight pounds per acre. The number of seedlings attacked was comparable on both organic and mineral soils, but mortality was greater on organic soil (Table 2). This was probably due to the fact that much earlier feeding occurred on the organic soils.

An analysis of variance indicated a significant difference in seedling mortality attributable to pales weevil between treatments and

the checks at the 5% level. The degree of control was computed using an adaptation of Abbot's formula (Table 1).

$$\frac{\%\text{ dead seedlings in control} - \%\text{ dead seedlings in treated}}{\%\text{ dead seedlings in control}} \times 100$$

TABLE 1 - Degree of pales weevil control achieved using DDT

Treatment	Bear Pen (organic soils)	(Pineland (mineral soils)
1. Pinolene + DDT	60.4%	92.6%
2. DDT + Triton	79.2%	63.2%
3. DDT + Pinolene + DDT Granular	84.5%	95.6%
4. DDT + Triton + DDT Granular	88.6%	94.1%

TABLE 2 - Summary of Pales Weevil Attack and Seedling Mortality

Treatment	% Attacked by Weevils	% Killed by Weevils
Bear Pen (organic soil)		
DDT - Pinolene	60.0	29.5
DDT - Triton	38.0	15.5
DDT - Pinolene + Granular	49.5	11.0
DDT - Triton + Granular	26.5	8.5
Check	80.5	74.5
Pinelands Tree Farm (mineral soil)		
DDT - Pinolene	46.0	2.0
DDT - Triton	57.5	12.5
DDT - Pinolene + Granular	25.0	1.5
DDT - Triton + Granular	34.5	2.0
Check	63.5	34.0

FIGURE 1 - Cumulative Seedling Mortality From Pales Feeding on Organic soil

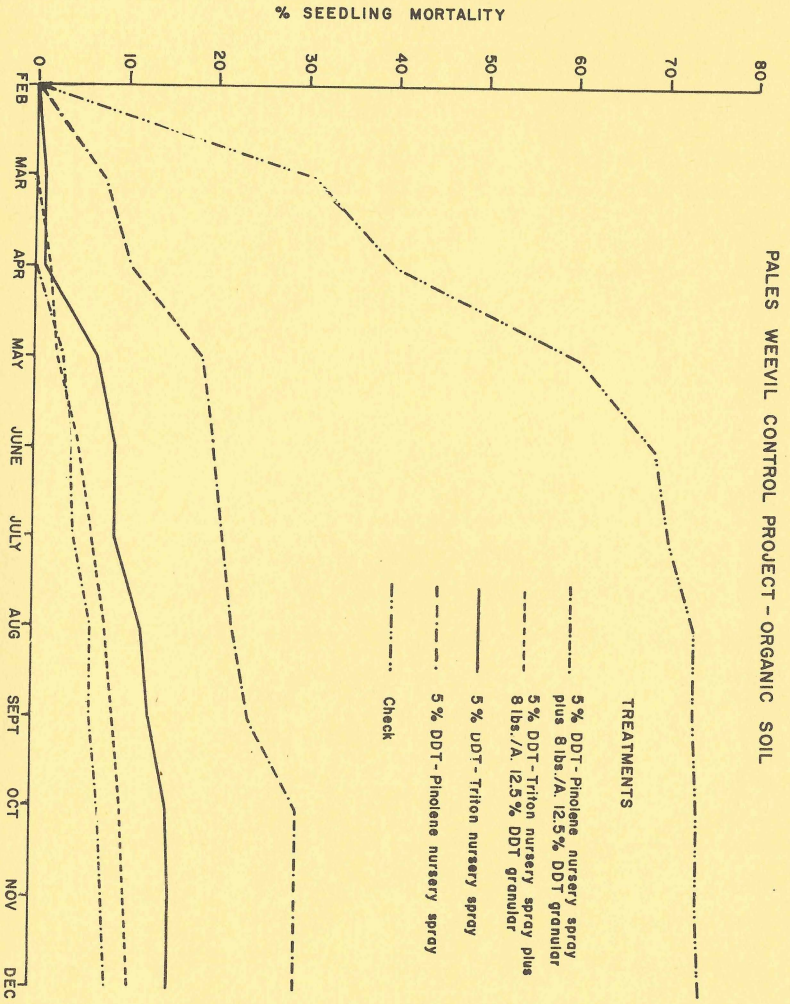
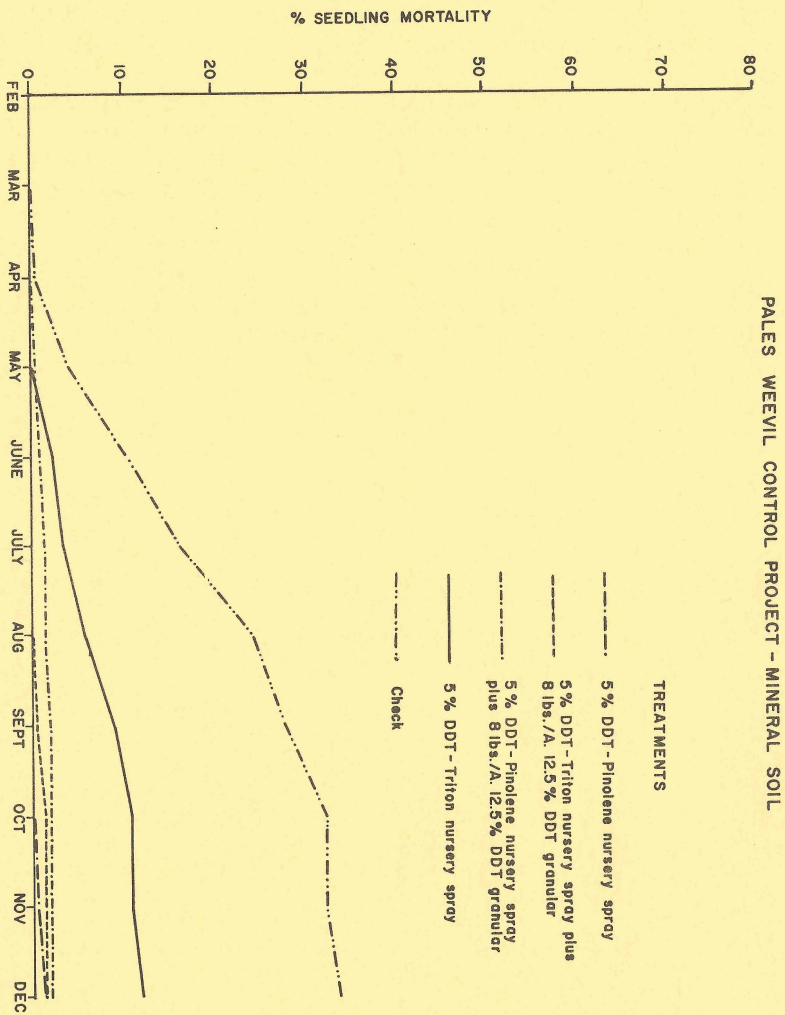


FIGURE 2 - Cumulative Seedling Mortality From Pales Feeding on Mineral soil.



RECOMMENDATIONS

It is generally recognized that the best possible method for reducing pales damage is to cut and site prepare before June prior to planting, or to delay planting for one growing season. This alternative, however, is not always acceptable to the forest manager because of economic or silvicultural factors.

Where a delay in planting is deemed unfeasible and site preparation prior to June is impossible, a satisfactory control for pales weevil may be obtained by planting seedlings which have been sprayed with five per cent DDT emulsion and further treating the outplanted area with a granular DDT broadcast on the soil at the rate of one pound technical per acre. This two-stage treatment should only be necessary on those areas which support extremely large populations of weevils. Generally, these areas will consist of extensive tracts of organic soil type on which continuous logging and site preparation operations are occurring for the purpose of regeneration of pine by planting. In North Carolina, these areas are confined to the Coastal Plain Region. On mineral soils and on small farm lot tracts that are to be planted following logging, adequate control should be obtained by using seedlings treated in the nursery with five per cent DDT emulsion spray.

REFERENCES

Beal, J. A., and K. B. McClintick. 1940. The pales weevil in southern pines. Journal of Economic Entomology 36: 792-794.

Carter, E. E. 1916. *Hylobius pales* as a factor in the reproduction of conifers in New England. Proc. Soc. Amer. Foresters (2): 297-307.

Friend, R. B. and H. H, Chamberlin. 1941. Some observations on pales weevil injury to white pine plantings in New England. Conn. Agric. Expt. Sta. Bul., 461: 530-537.

Finnegan, R. J. 1959. The pales weevil, *Hylobius pales* Hbst., in southern Ontario. Canad. Ent. 91: 664-670.

Pierson, H. B. 1921. The life history and control of the pales weevil, *Hylobius pales*. Harvard Forest Bul. 3, 33 pages.

Speers, C. F. 1958. Pales weevil rapidly becoming serious pest of pine reproduction in South. Jour. For. 56: 723-726.

Speers, C. F. 1958A. Effectiveness of three concentrations of Aldrin on pales weevil control methods. U. S. Forest Service, Southeast. Forest Expt. Sta. Res. Note 124, 2 pages.

Speers, C. F. 1956. Pales weevil control with insecticides: first year results. U. S. Forest Service, Southeast. Forest Expt. Sta. Res. Note 96, 2 pages.

Sentell, N. W. 1949. Pales weevil damages plantations in Louisiana. J. For. 47: 741.

Thatcher, R. C. 1958. Preplanting dips reduce weevil damage to pine seedlings. Jour. of Econ. Entomology, Vol. 51, No. 6, pp. 915-916.